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(54) **STERNUM REINFORCING DEVICE TO BE USED AFTER A STERNOTOMY OR A STERNAL FRACTURE**

STERNUMVERSTÄRKUNGSVORRICHTUNG FÜR DEN EINSATZ NACH EINER STERNOTOMIE ODER EINER STERNUMFRAKTUR

DISPOSITIF DE CONSOLIDATION DU STERNUM A UTILISER APRES UNE STERNOTOMIE OU UNE FRACTURE STERNALE

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Description

Technical Field

[0001] This invention relates to a sternum reinforcing device to be used after a sternotomy or a sternal fracture.

Background Art

[0002] The median sternotomy is a very usual operation in the field of heart surgery. The sternum or its portion of a patient is sawn by a saw or other cutting means. When all the sternum is severed in two, its sternal halves are spread apart laterally the one from the other so that mediastinum structures can be exposed. As a result, a large aperture is formed in the thoracic cavity, which permits an optimal surgical access to the heart and great vessels and also is well tolerated by the patient.

[0003] Once the operation is completed, the two sternal halves are rejoined. Traditionally, several means, such as Mersilene fibres, steel wires, metal and plastic bands, nitinol clamps, etc. are used for a sternal closure in order to assure the sternal stability and the recovery of the patient. The most usual current method of doing this is to use steel wires around the sternum passing through intercostal spaces.

[0004] However, both the medial sternotomy and the current methods are not free of complications. The complications of the sternal wound, usually due to the sternum instability, range from prolonged thoracic pains, which cause inconveniences and related respiratory disorders up to the dehiscence of the wound at the risk of infections and mediastinitis.

[0005] US Patent 4,583,541 already provides a sternal stabilizer for holding a severed sternum closed. Such a stabilizer consists essentially of a single strap-like member, which is adapted to overlie, in longitudinal and centrally relation, the anterior surface of a divided sternum of a patient. Such a strap-like member is provided with a plurality of pairs of through holes. A plurality of wires extend from the sternum posterior surface through holes formed in the sternum concentrically to the strap-like member through holes and are tied or twisted together within a central groove.

[0006] The above patent would intend to overcome problems occurring with the complications seen after median sternotomies. These problems range from wires breaking, wires protruding through the skin e.g. upon a patient's slimming, separation of the sternal halves, failure of the sternum to heal, infections and loose or unstable sternal halves.

[0007] Differently from the above patent that intends to protect a sternal stabilizer which appears to be limited in its function due to the need of fitting together holes in the sternum and those in the strap-like member, this invention aims to create a partial or full reinforcement for one sternal half or both, considering that sternotomy operations are carried out more often in elderly patients, whose skeletal system is losing more and more its strength in time.

[0008] US 2003/0083694 discloses an apparatus for closing a severed sternum comprising a first and a second transversal clamping structures adapted for intercostal positioning between two corresponding rib pairs. Each clamping structure has a projection member apt to engage a U-shaped chamber of the transversely opposite structure.

[0009] Also US 6,540,769 discloses an apparatus for closing a severed sternum comprising a transversal sliding attachment structure having projection members, the latter inserted through receiving chambers formed in a corresponding receiving attachment structure. WO02/067795 discloses a sternum fixation device comprising two removably associated plates.

[0010] None of such apparatuses, members and device is suitable for being arranged in series along the longitudinal edge of the sternum to act as a longitudinal reinforcement thereof.

[0011] Therefore, an object of the present invention is to manufacture a device adapt to be used in the sternal closure that provides a lateral reinforcement to the sternal halves as well as to both anterior and posterior portions of the sternum.

[0012] Another object of the invention is to perform a sternal closure similar to that could be made through a wire binding, without any risk of rubbing of the wire on the sternum which could generate subsequent lesions and consequent partial or complete fractures and wire loosening.

[0013] A further object of the invention is to permit a closure also in parts affected by partial or complete fractures of the sternurn, which are subsequent to a primary operation.

[0014] Yet a further object of the invention is to allow the sternal halves be closed during an operation for sternal dehiscence particularly without being necessary to separate any adherence being formed in meanwhile, which would involve a high risk of damage to the heart and any bypasses and relevant ducts.

[0015] Yet another object of the invention is to reinforce sternums which can be closed again by traditional methods at the risk of complications, owing to ageing or degeneration processes, such as the osteoporosis process, on patients that are affected also by diabetes, respiratory insufficiency, or obesity, or that have been subjected to paramedian sternotomies.

Disclosure of the Invention

[0016] Therefore, the invention provides a sternum reinforcing device as defined in claim 1. Preferred embodiments are defined in dependent claims 2-13.

Brief Description of Drawings

[0017] The present invention will be described refer-

ring to two preferred embodiment thereof, with connection to the enclosed drawing, in which:

Figure 1 shows a plan view of a plate blank which is shaped to obtain a first embodiment of the sternum reinforcing device;
Figure 2 shows in a perspective view the sternum reinforcing device in the form of an elongated member obtained by the plate blank in Figure 1;
Figure 3 shows in a perspective view a sternum reinforcing device having three elongated members as that one in Figura 2, which are mutually engaged consecutively;
Figure 4 shows a plan view of a plate blank which is shaped to obtain a second embodiment of the sternum reinforcing device;
Figure 5 shows in a perspective view the sternum reinforcing device in the form of an elongated member obtained by the plate blank in Figure 4;
Figure 6 shows an elevation side view of the sternum reinforcing device in Figure 5,
being rotated 90 degrees in the drawing sheet;
Figure 7 shows a top plan view of the sternum reinforcing device in Figure 6;
Figure 8 shows an end plan view of the sternum reinforcing device in Figure 6;
Figure 9 shows a plan view of a retaining splint;
Figure 10 shows in a perspective view a sternum reinforcing device having three elongated members as that one in Figure 5, which are mutually consecutively engaged and further provided with a retaining splint (partially shown) as that one in Figure 9; and
Figure 11 shows in a diagrammatic perspective view reinforcing devices, which are bilaterally fitted in a sternum.

Description of preferred embodiments

[0018] With reference to the drawings, shown in the plan view of Figure 1 is a first embodiment of the device in a semifinished condition, i.e. in the form of a punched plate blank (totally lying in the plane of the drawing sheet). The reinforcing device can be manufactured from a sheet of biocompatible material, e.g. stainless steel, being shaped by punching or other cutting process such as electrical discharge machining or laser cutting, etc. into a modular elongated member. Mechanical and technological characteristics of the material are selected in order to assure suitable mechanical working properties, usefulness and functionality to the device. Obviously, the reinforcing device can be obtained by machining as well as by casting, or from a not metallic material and by a different working method.

[0019] The elongated modular member 1 is shaped in a such way that a small body portion 4 is made in the form of a gusset in a intermediate position of the elongated modular member 1. The body portion 4 is contiguous to a central portion 5 of the modular member 1, a bending line l_4 being provided between them. Formed laterally to the body portion 4 are edges 2, 3 bordering on the body portion 4 along respective folding lines l_2, l_3, but being separated from the central portion 5.

[0020] The modular member 1 has connection parts in the form of arms 6, 7 being extended the one in one direction, the other in the opposite direction, with respect to the central portion 5. The arm 6, having a flat rectangular cross-sectioned profile, is slightly tapered toward its free end 8. The arm 7 is extended transversally by fins 9, 9, which can doubly bent by virtue of pairs of parallel bending lines $2l_9$, $2l_{10}$. The punched plate blank in Figure 1 is shown erected, ready to be used, in the perspective view in Figure 2. In this figure the body portion 4 is shown is orthogonally bent downward, thus as if it penetrates the drawing sheet, and the side parallel edges 2 and 3 of the body portion 4 are bent substantially at right angle outwards to form an U-shaped cross-section adapted to retain clamping means (to be described below).

[0021] Fins 9, 9 are doubly bent to form a so called channel hollow profile cross-section. Fins 9, 9 are bent upwards (as shown in Figures 2 and 3) or downwards (as later shown in Figures 5, 6, 7, 8, 10, and 11) with respect to the drawing sheet and then in parallel to the latter, by virtue of pairs of parallel bending lines $2l_9$, $2l_{10}$. It should be evident that the choice of bending the fins 9, 9 upwards or downwards in order to create a hollow cross-section, can be suggested by a more comfortable use in installing the device in the first case, and by a more finished front surface of the same device once it is in situ, in the second case, and by other remarks easy to understand.

[0022] In Figure 3 there is shown the sternum reinforcing device as a unit of three elongated modular members according to the first embodiment in their assembling step. Thus, this unit will be installed as shown in a diagrammatic perspective view in Figure 11. The elongated modular members are indicated generally as 1 and distinguished by an index in a plurality 1_1, 1_2, ..., 1_n, n being generally equal to 4 at the most.

[0023] As seen in Figure 3, the elongated modular members 1_1, 1_2, 1_3 are connected consecutively by means of prismatic sliding couplings, whereby the male arm 6 of the modular member 1_1 is fitted in the female arm 7 of the consecutive modular member 1_2, and the male arm 6 of the latter is fitted in the female arm of the consecutive modular member 1_3. The elongated modular members 1_1 and 1_2 fully interpenetrate, the end of the female part of the one abutting on the projecting edge 2 of the other. The member 1_3 is shown as spaced from the others.

[0024] The sizes of the body portion 4 are such that it can be fitted in the intercostal space of any patient. On the other hand, the longitudinal sizes of the arms 6, 7 and the amount of their mutual sliding are selected in such a way to allow the one elongated member and the consecutive one to be spaced so that they are adjusted to any rib width of a patient. In other words, a modular

member can be spaced from the consecutive one in the measure required for fitting the body portion in the relevant intercostal space, without loosing their mutual contact.

[0025] With reference to Figure 4, therein a second embodiment of the modular device, indicated as 10 as a whole, is shown by a plan view similar to that in Figure 1.

[0026] For clarity sake, in describing the second embodiment similar reference numerals and signs are used to indicate parts that are identical or similar to those of the first embodiment. The second embodiment differs from the first embodiment as the edges 2, 3 extend from the body portion 4 to form legs 20, 30.

[0027] The punched plate blank in Figure 4 is shown in its erected form, ready for its use, in the perspective view of Figure 5. Therein the body portion 4 is shown bent orthogonally downwards, thus as if it penetrates the drawing sheet, and the two lateral legs 20 and 30 are bent substantially 90 degrees outwards. As for the first embodiment, the fins 9, 9 are bent to form a channel-shaped cross-section. The counter-rotating arrows F indicate that the lateral legs 20, 30 can be bent in the opposite direction to abut themselves on the internal surface of the thorax in correspondence with the respective ribs in order to create a suitable clamping. Therefore, a material of which the reinforcing device is made has to be suitably bendable also only by hand.

[0028] The second embodiment is shown by three orthogonal views in Figures 6 to 8. It should be appreciated that Figure 7 is also a plan view of the first embodiment. In order to prevent a repetition, Figures 6 to 8 are not described in detail. A plan view of a retaining splint 12 to be used in connection with the second embodiment is shown in Figure 9. The retaining splint 12 is provided with slots 13 so dimensioned that the legs 20, 30 can pass through them. In one side of the retaining splint 12, there are wire guiding notches 14.

[0029] In the installation, a plurality of elongated modular members 10_1, 10_2, ..., 10_n are connected together by fitting the male arm 6 of a modular member in the female arm 7 of a consecutive modular member, as already explained for the first embodiment. When a sufficient number of elongated reinforcing members is reached, the installation in the thorax can be performed, by fitting male and female arms also not completely, in case, in order to respect the intercostal spaces. In Figure 10 there is shown how to fit legs 20, 30 of the retaining splint 12 in the direction of arrows G-G to create an internal greater clamping before rotating the same legs in the direction of arrows F-F.

[0030] As shown in Figure 11, two series of elongated reinforcing members are fitted from the front of the thorax, on anterior edge portions of a sternum that was subjected to a sternotomy or partial fracture. Figure 11 refers to the second embodiment, but it could refer also to the first one. If there are the legs 20, 30, once they are fitted, they are bent as indicated by the arrows F in opposite direction to be anchored in the internal part of the thorax. The legs 20, 30 can be bent after the retaining splint 12 has been fitted, which generates a better distribution of stresses in the thorax. At the end, the two series of reinforcing devices are locked by a wire 15 passing between the edges 2, 3 of each body portion 4. Although not shown in the drawings, the body portion 4 could be suitably bent to create a central guiding surface for the wire 14 already limited by the lateral edges 2, 3 bent outwards.

[0031] In such a way, the reinforcing device can be installed only where it is required. The tying wire is surrounded by the reinforcing device, and it will not imply the risk of sternal dehiscence due to loosening of wire or other complications, such as the rubbing of the sternal wires in the normal respiratory movements of the thorax.

[0032] By virtue of the particular reinforcing device, the sternum can be closed, besides by traditional wires, also by tapes and bands, which are suitably received between the edges 2, 3 of the body portion 4.

[0033] The elongated members can be used in a required number, and form together a single reinforcing group. Although in Figure 11, the elongated members are positioned both on one side and the other of the sternum in order to fully reinforce it, a less number of them can be used to reinforce only or partially a sternal half or both.

[0034] The use of the reinforcing devices can be avoided in those cases in which the sternum is in such good conditions that they are not required.

[0035] The persons skilled in the field will understand that modifications and variations can be made to the device as above set forth. Although in the embodiments described and illustrated the connection parts forms prismatic couplings, they could create different forms of coupling, either movable or adjustable, between an elongated member and another one. For example, the coupling of at least two pins, projecting upwards from an elongated member and being movable in a slot of a consecutive member could be chosen. Also the shapes of the parts can be different. For example, the body portion could be arranged not angularly to the remaining elongated member, but with some convexity fitting the lateral configuration of the sternum. It is intended that all modifications, if any, to the device, do not take away the device from the scope of the invention as set forth in the enclosed claims.

Claims

1. A sternum reinforcing device to be used after a sternotomy or a sternal fracture, which device comprises at least an elongated member (1; 10) apt to be used as a unit of a reinforcing group, which member (1; 10) is designed to be located on a surface portion of an anterior longitudinal lateral edge of a sternum and is provided with a central portion (5) and with a first and a second connection parts (6, 7),
said connection parts (6, 7) being in the form of arms

being extended the one in one direction, the other in the opposite direction, with respect to said central portion (5),
said first connection part (6) of said elongated member (1; 10) being adapted to join with a second connection part (7) of a preceding elongated member of the reinforcing group along the longitudinal lateral edge of the sternum, said second connection part (7) of said elongated member being adapted to join with a first connection part (6) of a following elongated member of the group along the same longitudinal lateral edge of the sternum, said elongated member (1; 10) being further provided with a projecting portion (4) designed to be fitted in an intercostal space adjacent to the longitudinal lateral edge of the sternum.

2. The device according to claim 1, **characterised in that** the connection parts (6, 7) of said elongated member (1; 10) are apt to form a prismatic coupling with the corresponding connection parts of the respective preceding and following elongated member of the group.

3. The device according to claim 1 or 2, **characterised in that** the elongated member (1; 10) is made from a biocompatible, shaped and bent plate material.

4. The device according to any of claims 1 to 3, **characterised in that** said first connection part is a male arm (6) adapted to be fitted slidingly in a corresponding second connection part (7) of a preceding elongated member.

5. The device according to claim 4, wherein said male arm (6) has a rectangular flat cross-section profile.

6. The device according to any of claims 1 to 5, **characterised in that** said second connection part is a female arm (7) adapted to be fitted slidingly in a corresponding first connection part (6) of a following elongated member.

7. The device according to claim 6, wherein said female arm (7) has a hollow channel-shaped cross-section.

8. The device according to claim 1, **characterised in that** said projecting portion for the intercostal space is a body portion (4) of the elongated member (1; 10) extending between said connection parts (6, 7) and at right angles to them.

9. The device according to claim 8, wherein said body portion (4) is U-shaped having parallel free edges (2, 3), orthogonally bent outwards, to enclose between them a clamping means (15) of the elongated member to same sternum.

10. The device according to claim 9, **characterised in that** said clamping means consists of a stainless steel wire (15).

11. The device according to claim 9 or 10, **characterised in that** said free edges (2, 3) of the U-shaped projecting portion (4) extend from the projecting portion (4) in the form of legs (20, 30) which can be fitted in the intercostal space of the thorax of a patient, laterally to the sternum, and bent in a mutually opposite direction, on the internal side of the thorax.

12. The device according to claim 11, **characterised by** comprising further a separated splint (12) provided with a multiplicity of slots (13) for the passage and the retaining of said legs (20, 30) before the legs (20, 30) being bent from the body portion (4) in a mutually opposite direction.

13. The device according to claim 12, **characterised in that** said splint (12) is provided, on one side thereof, with guiding notches (14) to accommodate said clamping means (15).

Patentansprüche

1. Sternumverstärkungsvorrichtung für den Einsatz nach einer Sternotomie oder einer Sternumfraktur, wobei die Vorrichtung wenigstens ein langgestrecktes Teil (1; 10) aufweist, das dafür ausgebildet ist, als eine Einheit einer Verstärkungsgruppe benutzt zu werden, wobei das Teil (1; 10) dafür ausgebildet ist, auf einem Oberflächenteil eines vorderen Längsseitenrandes eines Sternums angeordnet zu werden, und mit einem zentralen Teil (5) sowie mit einem ersten und einem zweiten Verbindungsteil (6, 7) versehen ist,
wobei die Verbindungsteile (6, 7) die Form von Armen haben, von denen sich der eine in eine Richtung erstreckt und der andere in der entgegengesetzten Richtung in Bezug auf den zentralen Teil (5),
wobei der erste Verbindungsteil (6) des langgestreckten Teils (1; 10) dafür ausgebildet ist, mit einem zweiten Verbindungsteil (7) eines vorhergehenden langgestreckten Teils der Verstärkungsgruppe längs des Längsseitenrandes des Sternums verbunden zu werden, wobei der zweite Verbindungsteil (7) des langgestreckten Teils dafür ausgebildet ist, mit einem ersten Verbindungsteil (6) eines folgenden langgestreckten Teils der Gruppe längs desselben Längsseitenrandes des Sternums verbunden zu werden, wobei das langgestreckte Teil (1; 10) weiter mit einem vorstehenden Teil (4) versehen ist, der dafür ausgebildet ist, in einen interkostalen Raum an dem Längsseitenrand des Sternums eingepasst zu werden.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verbindungsteile (6, 7) des langgestreckten Teils (1; 10) in der Lage sind, eine prismatische Kupplung mit den entsprechenden Verbindungsteilen des vorhergehenden und des nachfolgenden langgestreckten Teils der Gruppe zu bilden.

3. Vorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das langgestreckte Teil (1; 10) aus einem biokompatiblen, geformten und gebogenen Plattenmaterial hergestellt ist.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** der erste Verbindungsteil ein Steckarm (6) ist, der dafür ausgebildet ist, in einen entsprechenden zweiten Verbindungsteil (7) eines vorhergehenden langgestreckten Teils verschiebbar eingepasst zu werden.

5. Vorrichtung nach Anspruch 4, wobei der Steckarm (6) ein rechteckiges, flaches Querschnittsprofil hat.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der zweite Verbindungsteil ein Buchsenarm (7) ist, der dafür ausgebildet ist, in einen entsprechenden ersten Verbindungsteil (6) eines nachfolgenden langgestreckten Teils verschiebbar eingepasst zu werden.

7. Vorrichtung nach Anspruch 6, wobei der Buchsenarm (7) einen hohlen, U-förmigen Querschnitt hat.

8. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der vorstehende Teil für den interkostalen Raum ein Körperteil (4) des langgestreckten Teils (1; 10) ist, der sich zwischen den Verbindungsteilen (6, 7) und rechtwinkelig zu ihnen erstreckt.

9. Vorrichtung nach Anspruch 8, wobei der Körperteil (4) U-förmig ist und parallele, freie Ränder (2, 3) hat, die orthogonal nach außen gebogen sind, um zwischen ihnen eine Klemmeinrichtung (15) des langgestreckten Teils an demselben Sternum einzuschließen.

10. Vorrichtung nach Anspruch 9, **dadurch gekennzeichnet, dass** die Klemmeinrichtung aus rostfreiem Stahldraht (15) besteht.

11. Vorrichtung nach Anspruch 9 oder 10, **dadurch gekennzeichnet, dass** die freien Ränder (2, 3) des U-förmigen, vorstehenden Teils (4) sich von dem vorstehenden Teil (4) aus in der Form von Beinen (20, 30) erstrekken, die in den interkostalen Raum des Thorax eines Patienten eingepasst werden können, seitlich von dem Sternum, und in einer gegenseitig entgegengesetzten Richtung auf der inneren Seite des Thorax gebogen werden können.

12. Vorrichtung nach Anspruch 11, **dadurch gekennzeichnet, dass** sie weiter eine gesonderte Schiene (12) aufweist, der mit einer Vielzahl von Schlitzen (13) versehen ist für den Durchtritt und das Festhalten der Beine (20, 30), bevor die Beine (20, 30) von dem Körperteil (4) weg in einer gegenseitig entgegengesetzten Richtung gebogen werden.

13. Vorrichtung nach Anspruch 12, **dadurch gekennzeichnet, dass** die Schiene (12) auf einer Seite derselben mit Führungskerben (14) zum Aufnehmen der Klemmeinrichtung (15) versehen ist.

Revendications

1. Dispositif de consolidation du sternum destiné à être utilisé après une sternotomie ou une fracture sternale, lequel dispositif comprend au moins un élément allongé (1 ; 10) apte à être utilisé comme unité d'un groupe de consolidation, lequel élément (1 ; 10) est conçu pour être positionné sur une partie de surface d'un bord latéral longitudinal antérieur d'un sternum et est pourvu d'une partie centrale (5) et d'une première et une deuxième partie de connexion (6, 7), lesdites parties de connexion (6, 7) se présentant sous la forme de bras étendus l'un dans une direction, l'autre dans la direction opposée, par rapport à ladite partie centrale (5),
ladite première partie de connexion (6) dudit élément allongé (1 ; 10) étant adaptée pour être reliée à une deuxième partie de connexion (7) d'un élément allongé précédent du groupe de consolidation le long du bord latéral longitudinal du sternum, ladite deuxième partie de connexion (7) dudit élément allongé étant adaptée pour être reliée à une première partie de connexion (6) d'un élément allongé suivant du groupe le long du même bord latéral longitudinal du sternum, ledit élément allongé (1 ; 10) étant en outre pourvu d'une partie saillante (4) conçue pour être logée dans un espace intercostal adjacent au bord latéral longitudinal du sternum.

2. Dispositif selon la revendication 1, **caractérisé en ce que** les parties de connexion (6, 7) dudit élément allongé (1 ; 10) sont aptes à former un accouplement prismatique avec les parties de connexion correspondantes de l'élément allongé respectif précédent et suivant du groupe.

3. Dispositif selon la revendication 1 ou 2, **caractérisé en ce que** l'élément allongé (1 ; 10) est fait d'un matériau biocompatible, formé et courbé.

4. Dispositif selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** ladite première partie

de connexion est un bras mâle (6) adapté pour être monté de façon glissante dans une deuxième partie de connexion (7) correspondante d'un élément allongé précédent.

5. Dispositif selon la revendication 4, dans lequel ledit bras mâle (6) a un profil de section transversale plat rectangulaire.

6. Dispositif selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** ladite deuxième partie de connexion est un bras femelle (7) adapté pour être monté de façon glissante dans une première partie de connexion (6) correspondante d'un élément allongé suivant.

7. Dispositif selon la revendication 6, dans lequel ledit bras femelle (7) a une section transversale en forme de canal creux.

8. Dispositif selon la revendication 1, **caractérisé en ce que** ladite partie saillante pour l'espace intercostal est une partie de corps (4) de l'élément allongé (1 ; 10) s'étendant entre lesdites parties de connexion (6, 7) et à angle droit par rapport à elles.

9. Dispositif selon la revendication 8, dans lequel ladite partie de corps (4) est en forme de U ayant des bords libres parallèles (2, 3), courbés de façon orthogonale vers l'extérieur, pour enfermer entre eux un moyen de serrage (15) de l'élément allongé sur le même sternum.

10. Dispositif selon la revendication 9, **caractérisé en ce que** ledit moyen de serrage est constitué d'un fil d'acier inoxydable (15).

11. Dispositif selon la revendication 9 ou 10, **caractérisé en ce que** lesdits bords libres (2, 3) de la partie saillante en U (4) s'étendent depuis la partie saillante (4) sous la forme de branches (20, 30) qui peuvent être montées dans l'espace intercostal du thorax d'un patient, sur le côté du sternum, et courbées dans une direction mutuellement opposée, du côté interne du thorax.

12. Dispositif selon la revendication 11, **caractérisé en ce qu'**il comprend en outre une attelle séparée (12) munie d'une multitude de fentes (13) pour le passage et la retenue desdites branches (20, 30) avant que les branches (20, 30) soient courbées depuis la partie de corps (4) dans une direction mutuellement opposée.

13. Dispositif selon la revendication 12, **caractérisé en ce que** ladite attelle (12) est pourvue, sur un de ses côtés, d'encoches de guidage (14) destinées à recevoir ledit moyen de serrage (15).

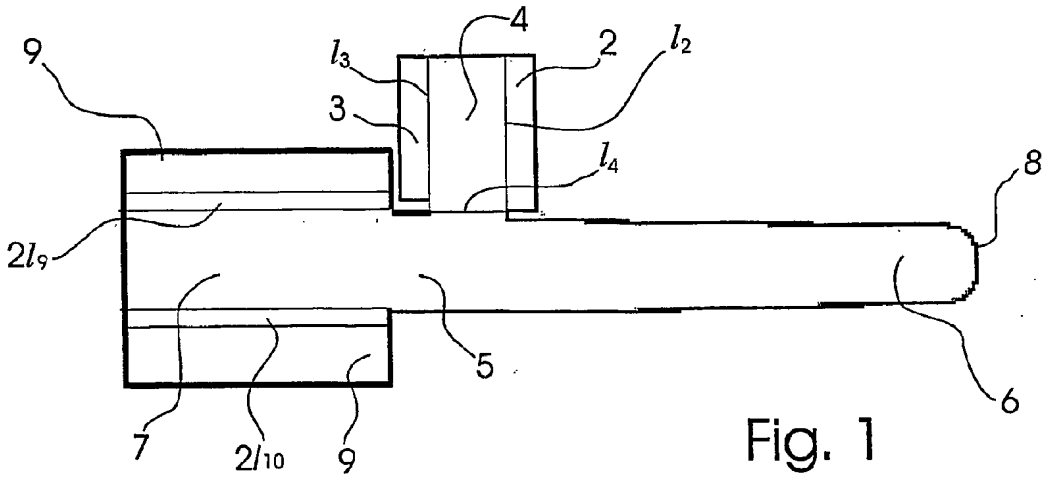


Fig. 1

Fig. 2

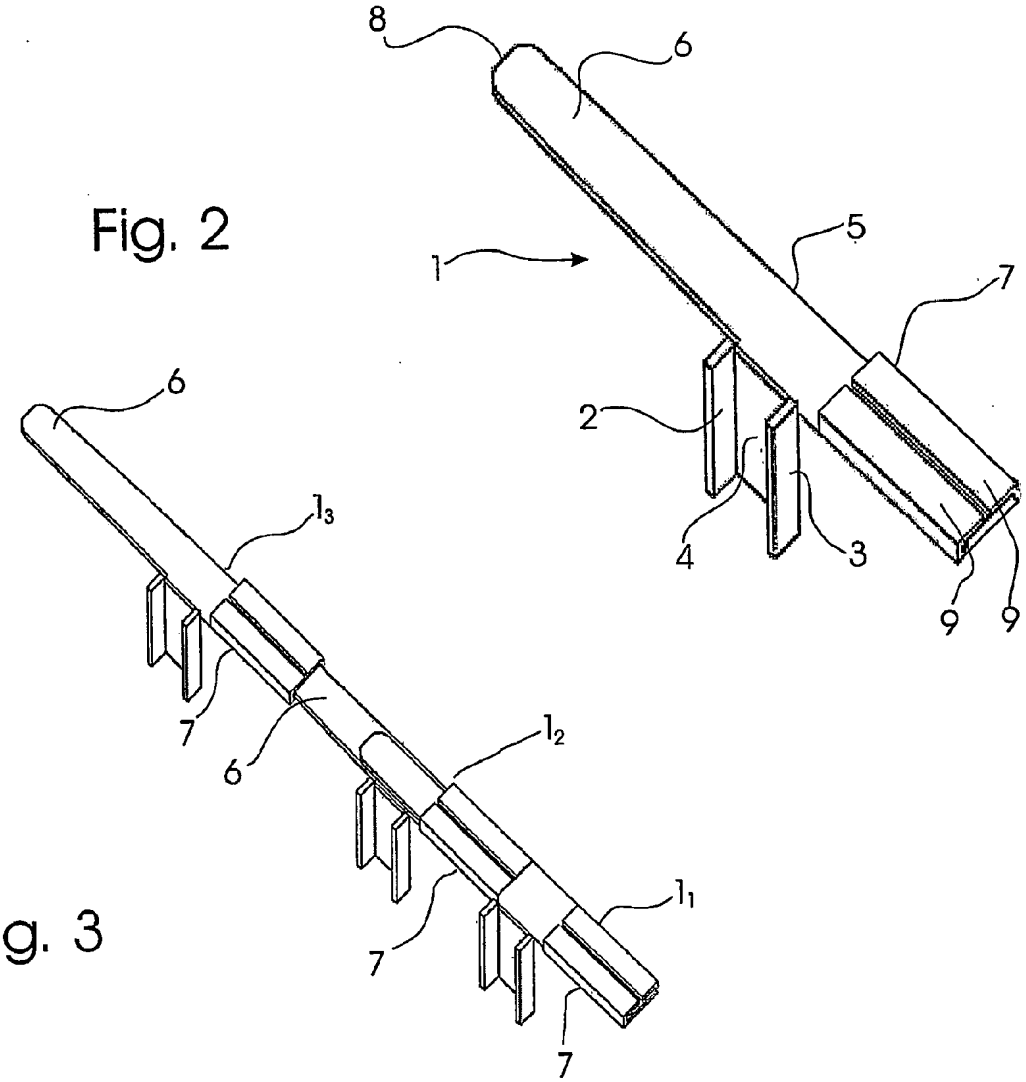
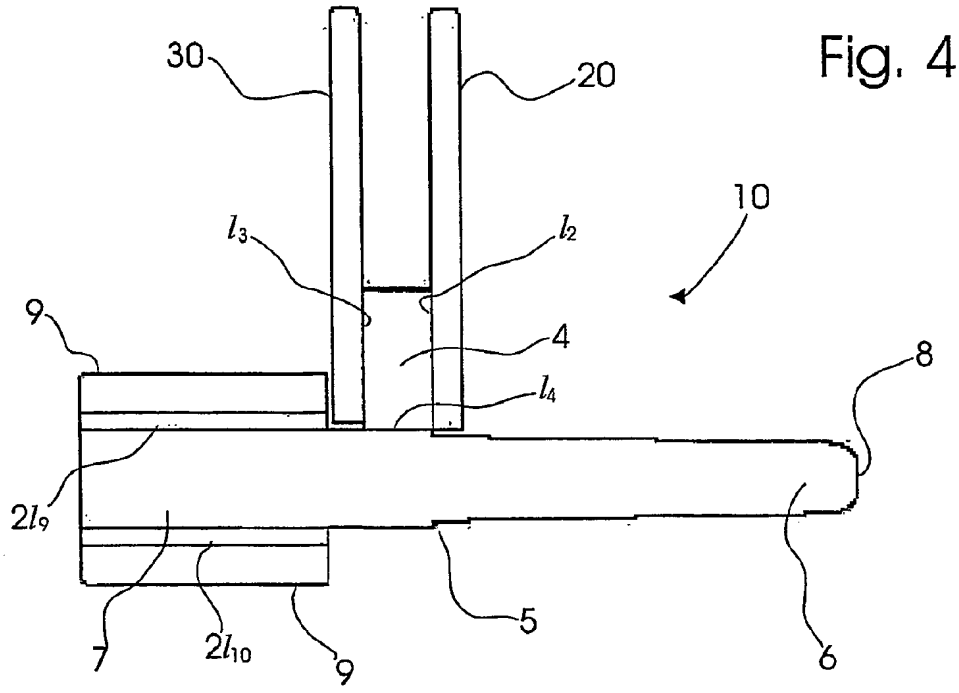


Fig. 3



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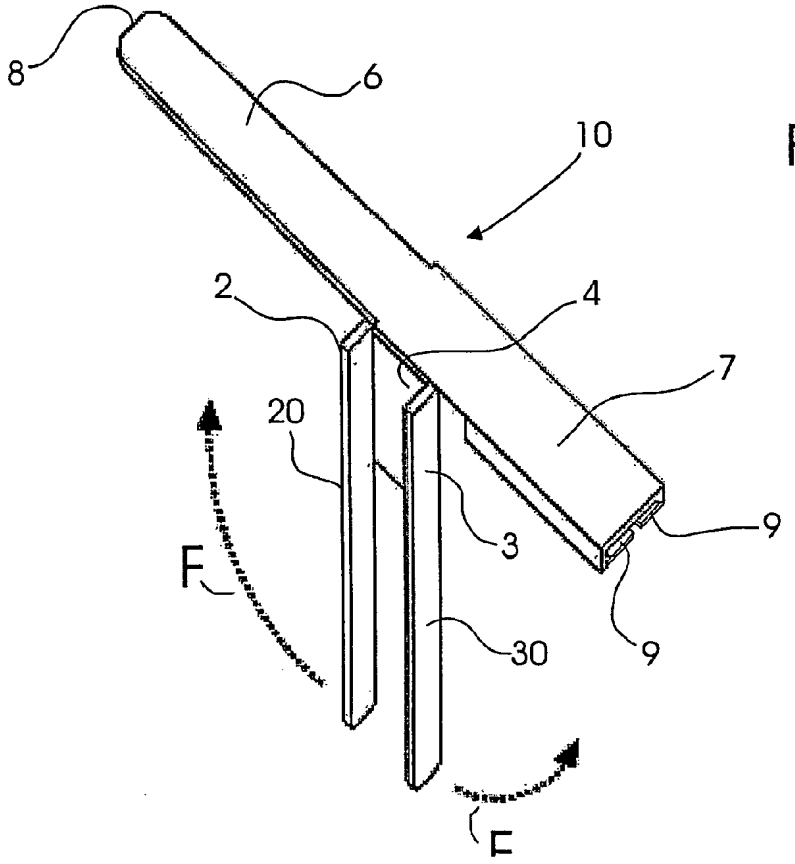
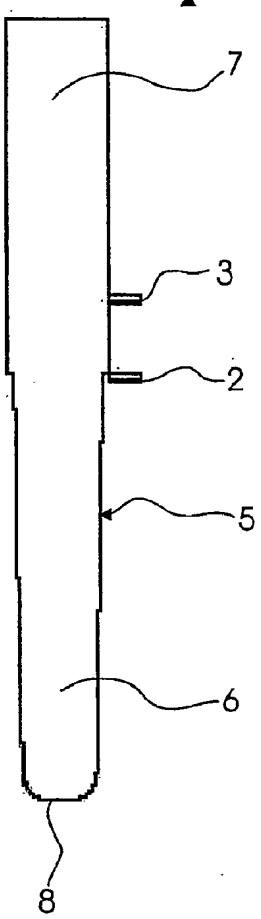


Fig. 5

Fig. 7



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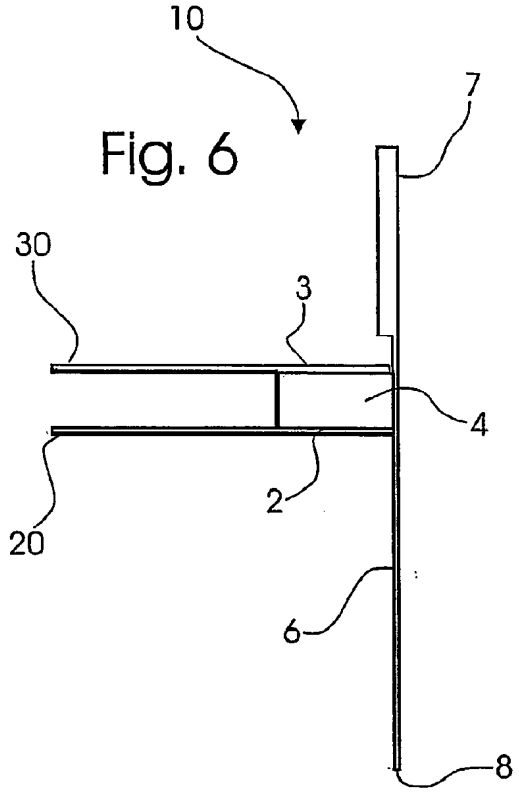
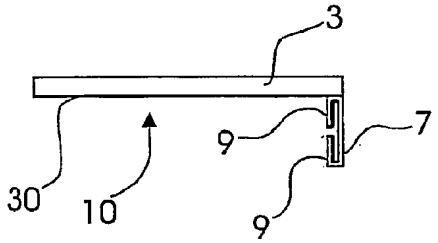


Fig. 8



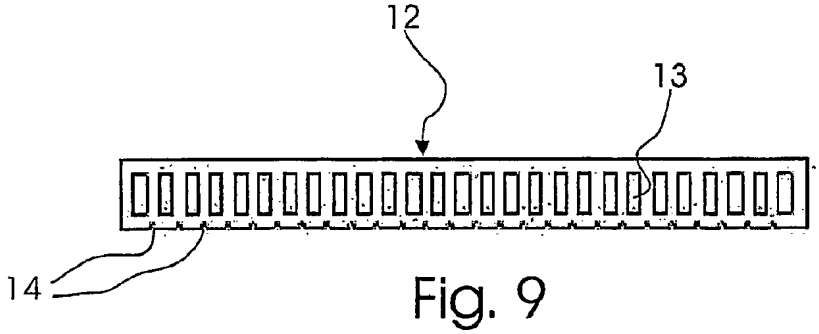


Fig. 9

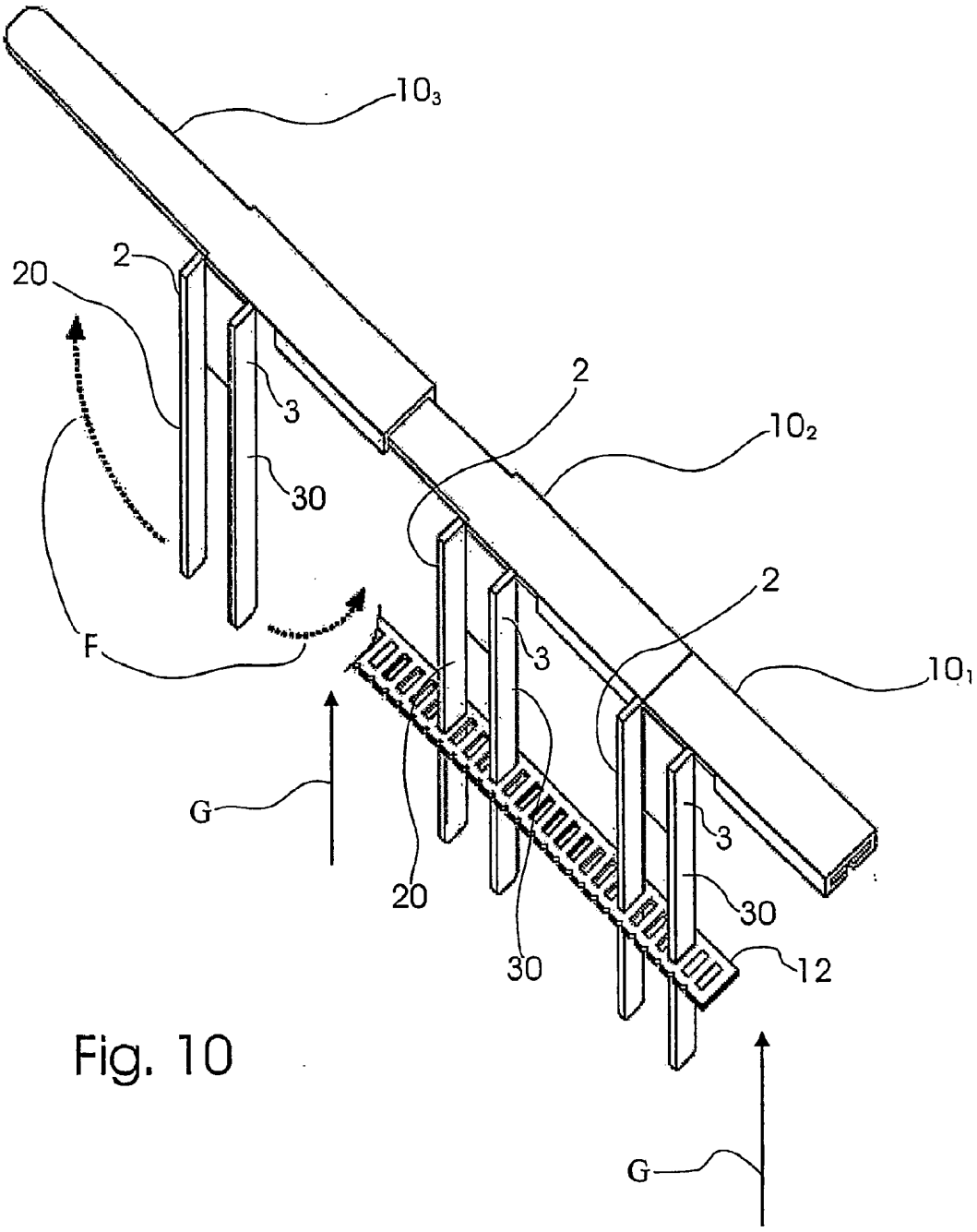


Fig. 10

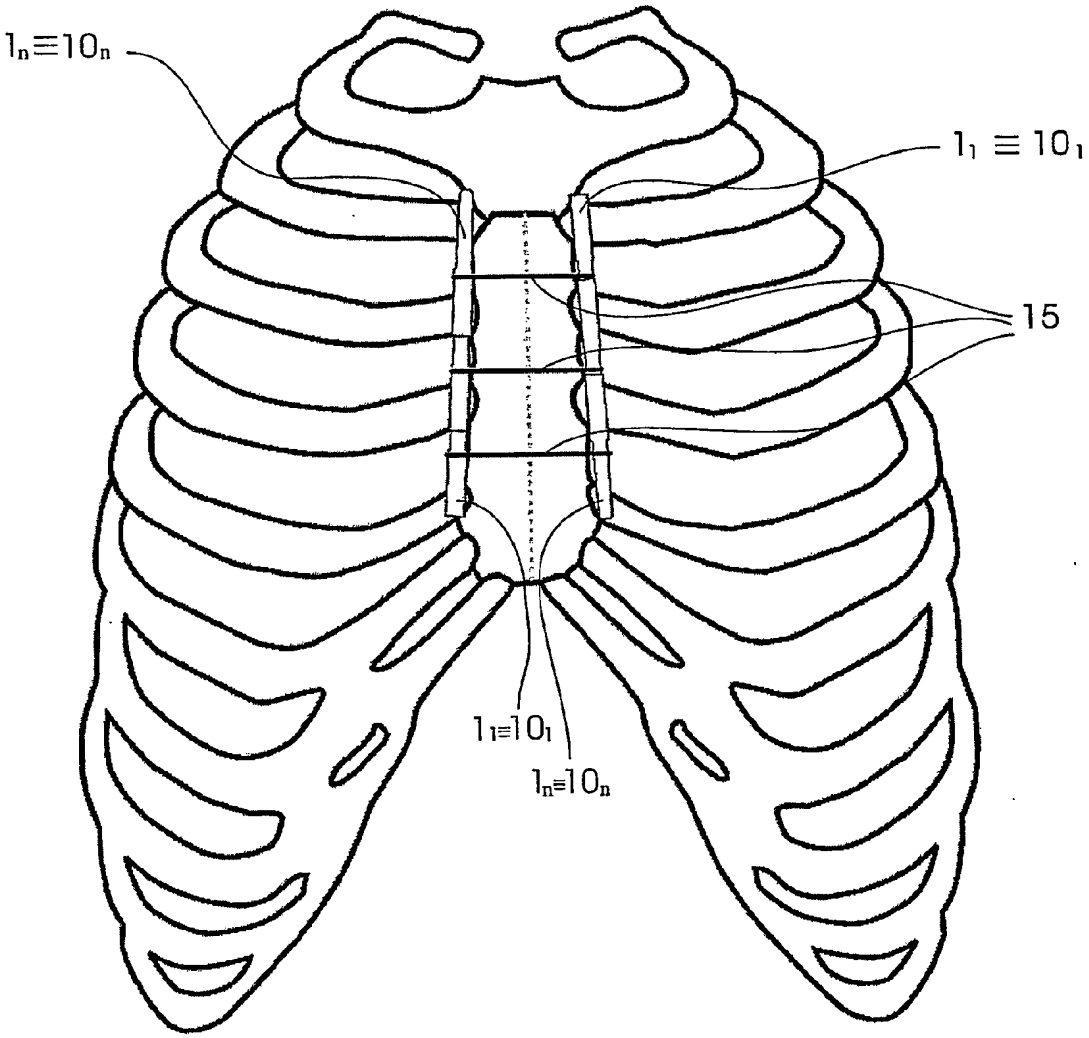


Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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